4.13 Lifecycle Engineering

Lifecycle Engineering (LCE) seeks to maximize a product's contribution while minimizing its cost to the manufacturer, the user, and the environment. LCE design addresses manufacturability as well as issues related to the entire product lifecycle. It pays strict attention to the environment in which the product will operate. Decisions made in early design stages can determine more than 80 percent of the lifecycle cost. Consequently, LCE focuses on design and manufacturing decisions that will significantly impact the product lifecycle cost. LCE requires designers to estimate the lifecycle cost and attribute it to the design and manufacturing decisions.

LCE assesses and confirms system attributes. LCE analyses supplement the program to define constraints and design features or describe characteristics of the design and related operations. These analyses provide technical details of the design and are performed throughout the product's lifecycle. At minimum, analysis results shall be available at standard design milestones, including the preliminary and critical design reviews. These analyses are used to evaluate design progress, technical soundness, and risk. They are also needed by the stakeholders to ensure that the product performs as intended, as well as by engineering, operations, and product support personnel to accomplish their responsibilities in product development and operation. LCE inputs, process tasks, and outputs are summarized in Figure 4.13-1.

LCE interacts with several other system engineering activities, receiving and providing information that relates and impacts each activity. Requirements Management (provides Mission Need Statements and requirements to LCE. LCE develops constraints and feeds them back to Requirements Management to be developed into requirements, as applicable. Similarly, LCE provides constraints to Synthesis. These constraints are then considered during the Synthesis process.

LCE provides planning criteria to Integrated Technical Planning (ITP). Several plans developed in ITP are used during the LCE process. Details of the products received from and provided to other activities are discussed in later paragraphs.

LCE is used to identify constraints for system lifecycle attributes, including:

- National Airspace Integrated Logistics Support
- Deployment and Transition
- Real Property Management
- Sustainment/Technology Evolution
- Technological Opportunities
- Disposal

Process:

Perform Lifecycle Engineering

ID No.: 4.13 (iCMM PA 09, 10)
Date: April 13, 2004
Revision Date: September 30, 2004

Next Higher Level Process:
Perform System Engineering

Process Owner:
System Engineering Council

Process Objective:
To assess and confirm system attributes.

Inputs

a) Constraints
b) External environmental forces
c) Government and international regulations and statutes
d) Market research
e) FAA policy
f) Technology
g) Concerns/issues
h) Integrated Lifecycle Plan, IPP, NAS Architecture, SEMP
i) MNS, requirements
j) OSED
k) Design constraints
l) Trade study reports
m) Design analysis reports
n) Analysis criteria
o) Approved Baselines, Approved Baseline Changes, Configuration Status Accounting Report

Providers

a) EXT
b) EXT
c) EXT
d) EXT
e) EXT
f) EXT
g) EXT
h) ITP
i) RM
j) FA
k) Syn
l) TS
m) SpecEng
n) IA
o) CM

PROCESS TASKS

Beginning Boundary Task

Plan and Perform National Airspace Integrated Logistics Support (NAILS)

- Plan and Perform Deployment and Transition
- Plan and Perform Real Property Management
- Plan and Perform Sustainment/Technology Evolution

Ending Boundary Task

Plan and Perform Disposal of Equipment

Lifecycle Phase

- ☑ Mission Analysis
- ☑ Investment Analysis
- ☑ Solution Implementation
- ☑ In-Service Management
- ☑ Service Life Ext.
- ☑ Disposal

Outputs

a) LCE planning criteria
b) Lifecycle cost estimate
c) Constraints
d) LCE tools and analysis requirements
e) Concerns/issues
f) Commissioned system
g) System disposal
h) Real property assets
i) Change Requests
j) Change Release Notices
k) Configuration Documentation

Customers

a) ITP
b) Syn, TS
c) RSK, TS, RM, Syn
d) IA
e) RSK
f) EXT
g) EXT
h) EXT
i) CM
j) CM
k) CM

Figure 4.13-1. The Lifecycle Engineering: Inputs, Tasks, and Outputs

4.13.1 National Airspace Integrated Logistics Support

National Airspace Integrated logistics support (NAILS), a critical functional discipline, establishes and maintains a support system for all FAA products and services. The objective shall always be to provide the required level of service to the end user at minimal lifecycle cost to the FAA. This policy applies not only to new acquisition programs, but also to the sustainment of fielded products and services. LCE is responsible for all logistics activities during the life of the system and determines all program logistic attributes.

> (Note: NAILS and Integrated Logistics Support (ILS) (not Instrument Landing System) are the same and are used interchangeably. FAA documentation refers to both NAILS and ILS. Both are included in this explanation in case one of the other terms is used during the course of procurement.)

NAILS provides a structured discipline for defining support constraints and acquiring support assets so that fielded products can be operated, supported, and maintained effectively over their entire service life. The primary goal of NAILS is high product availability at the lowest cost.

NAILS is responsible for identification and acquisition of the support items identified as a result of an analysis of the elements. The nine elements currently used by the FAA that need to be addressed are:

1. Maintenance planning
2. Maintenance support facility
3. Direct-work maintenance staffing
4. Supply support
5. Support equipment
6. Training, training support, and personnel skills
7. Technical data
8. Packaging, handling, storage, and transportation
9. Computer resources support

It is fundamental to sound ILS planning that these elements are addressed within the context of each phase of the product's lifecycle (mission analysis, investment analysis, solution implementation, and in-service management). It is also necessary to manage the interdependencies among these elements within each phase while adhering to the principles of asset supply chain management (i.e., integration of suppliers, users, and schedules).

NAILS shall determine the parameters of the equipment (reliability, maintainability, and availability). These values will have a direct impact on sparing, depot maintenance, training, maintenance planning, and other elements. The key to a successful acquisition is close communication between the logistics representative and system engineer.

4.13.1.1 Inputs

Several inputs are needed to facilitate effective NAILS planning and execution. FAA and Air Traffic Organization (ATO) policy, market research, technology, contractor analysis, and other concerns and issues must be considered.

Additionally, design constraints and trade study reports provide information needed to choose between various alternatives.

4.13.1.2 Process

The typical steps involved in the NAILS process are:

- Develop NAILS constraints
- Define maintenance concept and support strategy for candidate solution
- Develop NAILS performance, cost, and schedule benefits
- Define strategy for satisfying support requirements
- Define work tasks for obtaining support
- Develop NAILS input for the procurement package
- Perform support analysis tasks
- Define maintenance support facility constraints
- Acquire NAILS assets
- Conduct in-service readiness review for NAILS

4.13.1.3 Outputs

NAILS outputs include the Integrated Logistics Support Plan (ILSP), maintenance concepts, support requirements, and any related concerns and issues. The ILSP describes how the FAA will support each logistics element. This document is developed early in the lifecycle, coordinated with system engineering, and is updated as information is further defined. It forms the basis for the contractor's Integrated Support Plan.

4.13.2 Deployment and Transition

Deployment planning prepares for and assesses the readiness of a solution to be implemented into the National Airspace System. Deployment planning is part of a continuous In-Service Review (ISR) process that begins early in the lifecycle management process, usually during the development of requirements. All programs undergo some degree of deployment planning to ensure that key aspects of fielding a new capability are planned and implemented, as well as to ensure that deployment does not create a critical deficiency in the National Airspace System (NAS). The level of authority for deployment readiness assessment and In-Service Decision (ISD) may vary from the service organization leader to the chair of the Joint Resources Council.

4.13.2.1 Transition

Transition involves all work activities for installing the new system at the key site, conducting the tests for making the ISD, and transitioning from the existing system to the new. It also covers all work activities to install subsequent systems at each operational site and qualify them for operational service. This includes a plan on how to transition operations and maintenance from the existing system to the new system. The scope of activities includes preparing the site, installing and testing the equipment, conducting dual operations, familiarizing field personnel with the new equipment, obtaining full operational support, and removing and disposing of replaced assets. Trouble-free deployment and transition requires thorough planning early in the lifecycle and close cooperation between the product team, facility team, system contractor, and regional and site personnel during deployment.

4.13.2.2 Inputs

The implementation schedule identifies when each site will receive the new equipment and dispose of the old. The test schedule is used in developing the overall deployment or implementation schedule. FAA/ATO policy will identify the steps for deployment and commissioning.

4.13.2.3 Process

The conduct of deployment planning involves coordination among and participation by many critical functional disciplines. Tradeoffs among cost, schedule, performance, and benefits relative to these functional disciplines must also include the impact of deployment and implementation considerations. Deployment planning tools (such as a tailored In-Service Review (ISR) Checklist) shall be used to assist in identifying, documenting, and resolving deployment and implementation issues. Methods and techniques include, but are not limited to, a tailored application of generic tools, integration of checklist issues with other emerging issues (such as problem test reports from program tests and evaluation), development of action plans for resolution of checklists and other items, and documentation of the results of issue resolution and mitigation. Consistent deployment planning shall be visible in the contractor Statement of Work and associated efforts. The results of deployment planning (and issue resolution) activities are briefed periodically (e.g., at acquisition reviews), presented at the ISD meeting, summarized in an ISD memorandum, and audited during the post-ISD follow-up and monitoring activities. Typical activities used to deploy and transition from the existing system to the new system are:

- Develop cutover plan for key site
- Prepare key site for new system
- Install and check out system at key site
- Integrate and test system at key site
- Prepare Independent Operational Test Readiness Declaration
- Conduct Independent Operational Test and Evaluation
- Conduct field familiarization testing for key site

- Prepare for the In-Service Decision
- Obtain the In-Service Decision
- Conduct dual operations at key site
- Commission key site into operational service
- Dispose of replaced assets at key site
- Develop cutover plan for each site
- Prepare each site for new system
- Install and check out system for each site
- Integrate and test system for each site
- Conduct field familiarization testing for each site
- Conduct dual operations for each site
- Commission in operational service for each site
- Dispose of replaced assets for each site

4.13.2.4 Outputs

The final ISR Checklist will be completed and the ISD will be made. This allows the system to be deployed to the field. The final output of deployment and transition is a commissioned system and the disposal of the old system.

4.13.3 Real Property Management

Accountability for real property is the process of ensuring that the real property assets for all FAA owned, leased, and utilized real property assets are recorded. Functions of real property accountability may include, but are not limited to, documentation, verification, and confirmation of the existence of real property records and are to be documented in an automated information system.

All FAA real property assets are recorded and managed by the Assistant Administrator for Financial Services. More information may be found in the Interim Fixed Asset System database (http://www.faa.gov/aba/html_fm/ifas.html).

4.13.3.1 Inputs

The outputs include a list of space constraints, location of existing equipment, and recommendations for new or modified facilities for the product. Facility drawings showing equipment location, spares storage, support equipment and test benches, and other items that use space will be identified.

4.13.3.2 Process

The system engineer is responsible for the following tasks related to property management:

- Determines whether real estate must be acquired for FAA-related projects by identifying space constraints, locations, and the requirement for new or modified facilities
- Notifies real estate experts of need for purchase and ensures that the property is recorded in the real estate database upon purchase/lease

4.13.3.3 Outputs

The results of the real property analysis will form the basis to determine what real property will be required. Real property management will use this recommendation to obtain (through purchase, lease, or other arrangement) any necessary property assets, with the assistance of real estate experts.

4.13.4 Sustainment/Technology Evolution

4.13.4.1 Inputs

The Sustainment/Technology Evolution process may need any or all of the following inputs:

- Design constraints
- External pressures
- Operations and maintenance costs
- A list of spares that are difficult or impossible to obtain
- A list of new technology developments and components that can be used to enhance the sustainment of systems
- A list of new commercial products and results from market research
- Demonstrations by vendors

4.13.4.2 Process

The Mission Need Statement serves as the basis for investment analysis and is revalidated at the investment decision. LCE shall ensure that logistics inputs are included in this statement. As a program proceeds through implementation, fielding, sustainment, upgrade, and eventual replacement, the Mission Need Statement is revalidated periodically. The Integrated Product Team (IPT), working with the field users, will assess the current performance of existing equipment and provide an analysis of how best to sustain as well as plan for future upgrades or replacements (Figure 4.13-2).

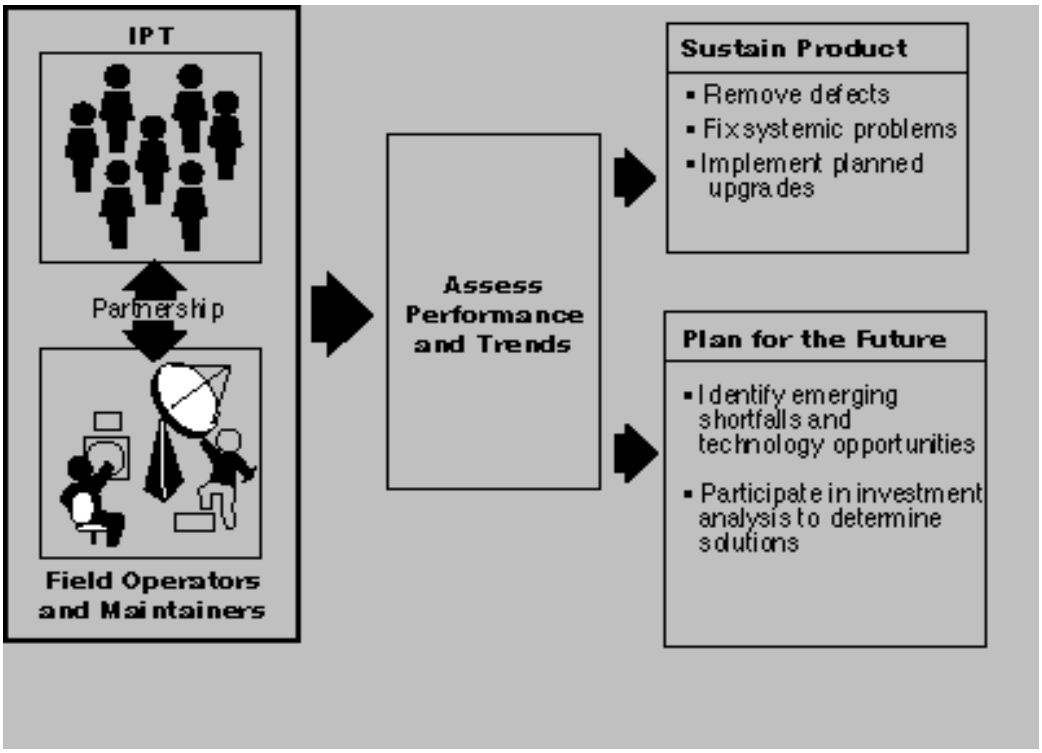

Figure 4.13-2. IPT Assessment of Equipment Performance

Preplanned product improvements may be implemented as stipulated at the investment decision. Sustainment resources in the acquisition program baseline may be used to upgrade components of fielded products (e.g., printers or processors) as needed. The objective is to develop evolutionary products and rapidly insert new technology, rather than to periodically replace fielded products wholesale.

LCE assists the service organization and its system engineering efforts throughout the lifecycle in collecting and assessing data for use in evaluating product or service effectiveness. These activities shall include:

- Tracking and evaluating RMA performance and supportability issues
- Analyzing supportability issues caused by market-driven products and analyzing system or subsystem obsolescence
- Determining the most cost-effective means of avoiding projected supportability shortfalls
- Assessing integration of obsolescence-driven system changes with new constraints
- Evaluating the impact of engineering changes, performance shortfalls or technological opportunities on ILS products and support services
- Supporting revalidation or development of Mission Need Statements

4.13.4.3 Outputs

Outputs include a plan to correct systemic problems and remove defects from systems and implement planned upgrades and a list of emerging shortfalls and technology enhancements for future systems. Lessons learned databases may contain samples of these plans, or the product team may have examples.

Service Life Extension Programs may also be used to keep older systems in the field by incorporating new technology. This may increase the service life of the system and lower maintenance costs.

4.13.5 Technological Opportunities

Some technological opportunities may result based on the decisions related to the logistics elements described above. If the decision is to use commercial-off-the shelf (COTS) products, LCE should identify those items that will probably become obsolete within 5–7 years. This creates a need to develop a plan to support these items in the out years of the system's lifecycle. LCE recommends preplanned product improvement or alternative improvement options.

4.13.5.1 Inputs

Inputs may include results of an analysis of the existing system showing opportunities for insertion of technology, a listing of new products available in the commercial market place (COTS), operations and maintenance costs of existing systems, and results of an Investment Analysis.

4.13.5.2 Process

Operational performance is monitored and analyzed, and data is provided to IPTs as a basis for optimizing current operations and planning for future upgrades. IPT sustainment engineering provides COTS product obsolescence projections and determines their potential impact on system operational capability and sustainment. LCE, in its data analysis, will:

- Monitor and analyze system performance
- Optimize current operations
- Identify technology opportunities and plan for future upgrades
- Identify obsolescence issues and determine the impact
- Develop a plan and schedule to reduce or eliminate these issues

A Mission Analysis Team may determine that a technological opportunity is beyond the scope of an existing Acquisition Program Baseline. If this offers a potential for improving safety, significantly lowering costs, or improving effectiveness, a new mission analysis should be initiated. The operating organization, with the cooperation of the IPT responsible for the current capability, should initiate the new mission analysis. Section 3.0, Needed Capability, of the Mission Need Statement should describe the technological opportunity. The description should not seek to justify a specific solution or an acquisition program.

LCE may solicit product improvement/technology enhancement proposals for FAA review. Contractors are encouraged to discuss product improvement/ technology enhancement ideas with the FAA before preparing and submitting a formal proposal. These proposals should suggest methods for performing more economically and/or methods for incorporating emerging technology.

4.13.5.3 Outputs

Outputs may include, a list of available commercial equipment that will meet the needs of the FAA for replacement (in part or whole) or enhancement of an existing system; estimated costs for operations and maintenance associated with a technology insertion (cost savings over the lifecycle compared to other alternatives); and a recommended list of equipment and components that are available.

4.13.6 Disposal

An important element of any product's lifecycle is the process used to remove facilities from the NAS operational inventory and ultimately disposed of them. Besides funding concerns, a number of logistics issues shall be considered as a system approaches the end of its commissioned life.

Disposal includes all activities associated with disposal management, dismantlement/demolition/removal, restoration, degaussing, or destruction of storage media and salvage of decommissioned equipment, systems, or sites.

4.13.6.1 Inputs

Potential inputs include:

- Implementation schedule for the new system and proposed dates for removal of the existing system
- A list of spares, line replaceable units, documentation, and other items related to the system being replaced
- A list of any hazardous materials or items that need special handling

4.13.6.2 Process

SE efforts to support disposal of a system being replaced occur during the new system's implementation phase. The ITP process is used to develop a Disposal Plan under FAA Order 4800.2, Utilization and Disposal of Excess and Surplus Personal Property. LCE supports the ITP in developing a disposal plan that identifies the systems, components, assemblies, and so forth that will be removed, disposed of, or cannibalized; any environmental issues; place of disposition; the person responsible for disposal: as well as many other factors. Previous disposal plans contain examples of items that should be considered.

LCE shall conduct an assessment of the system to determine the need to scavenge usable parts/subsystems from facilities slated to be decommissioned. This source of usable parts/subsystems is particularly important for items that are no longer being manufactured.

This opportunity must be weighed against the costs of component removal, shipping, shop/vendor refurbishment, and warehousing. LCE may require the services of an engineering service in determining any hazardous materials within the system.

4.13.6.3 Outputs

Outputs may include:

- A schedule identifying when each existing system will be removed and shipped to a disposal location
- A list of items that contain hazardous materials or precious metals or that need special handling
- A list identifying items that can be used in other systems

4.13.7 Tools

Tools include:

Logistics Information System. This is the inventory control and ordering system for the FAA.

Spares Planning Model. A model that assists in the provisioning process by estimating the range and quantity of spares based on failure rates, cost, and other factors.

Logistics Management Information guidance. This guidance is used to identify to the contractor the logistics analysis required on the system and the expected outcome.

Barcoding. Barcoding methodology is defined in the statement of work. It is used to track spares and configuration management of the system.

FAA Acquisition Toolset. This is FAA's reference for all documents and tools used during the acquisition process.

Interim Fixed Asset System database. This FAA database records real property assets and is managed by Financial Services (http://www.faa.gov/aba/html_fm/ifas.html).

4.13.8 References

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